Interview Summary

Examiner Derek Chapel and I (Bernhard Bausenwein) discussed the claim 31 (the independent, generic claim of the disclosure). This claim relies strongly on the definition of the polarizing layer vectors Vi, and certain planes derived from Vi. I stated that the final rejection, OA dated 7.7.2010, is based on a misconception of these polarizing layer vectors, and I also pointed out the fact that the prior art needed additional polarization rotating components (wave-plates) to achieve what our disclosure achieves simply with the polarizing beam splitting layers.

The examiner agreed that the former art (Fulkerson; Flood) would not work without the wave-plates.

The examiner therefore suggested to discuss the layers vectors and the planes in earlier art. (For these vectors were only introduced with our disclosure, they are not contained or readily recognizable in the prior art publication, the same applies for the planes used in our independent claim).

The examiner also suggested in addition to the points mentioned in the final rejection, the claim 31 to be amended to include the fact that there are no wave-plates between the different beam splitting layers.

The examiner informed me about the different time schedules of an appeal and an RCE, and I indicated that an RCE would be considered.

Detailed remarks

The rejection of the last office action is - in our view - clearly based on a misconception of the vectors and planes which are fundamental to our independent claim 31. This has also been corresponded in the interview.

In this response we explain the layer vectors again, and more importantly, relate these to the former art, in which they are neither contained nor readily recognizable.

We think that our introduction of the polarizing layer vector (V) is a convenient, and, once understood, relatively simple term to characterize the most important property of a beam splitter, to indicate how the plane of polarization (POP) of the reflected, and less direct, also that of the transmitted beam will look. Before the arrival of cartesian beam splitters, there was no necessity for such a term, because the POP was directly coupled to the plane of incidence (POI), and only two possible means, perpendicular ("S") or parallel ("P") polarization planes were possible (all with respect to the POI). Our vector V covers these cases, too, but is really helpful with wire grids and other cartesian polarizers, where the POPs are independent on POI.

The vector V, as defined by us is a direction vector (thus its length is not important), given by the intersection line of the polarizing beam splitting layer itself, and the POP of any beam reflected by this layer. Differently put, V is coplanar to the layer itself, and V is also coplanar to the POP of the reflected beam.

Illustration R1 of this response shows the vectors in the prior art of Flood (US2,449,287). The plane of incidence (POI) is parallel to the indicated ground plane of the planar arrangement. We have included the ground plane in the drawing, because the prior art of Flood and the prior art of Fulkerson et al. (US6,490,087) show arrangements of multiple polarizers in a planar arrangement. A beam, incident on the optical axis A1 is split at P1 such that a sub-beam with a certain polarization ("S") is reflected by P1, and a beam with the "complementary" polarization ("P") is transmitted

by the polarizer. The "S" polarized beam has its Plane of Polarization (POP) perpendicular to the POI or ground plane of the arrangement, the "P"-polarized beam has its POP parallel to the POI.

This vector V describes the polarizing effect of a polarizing beam splitting layer independently from its structural design or its mode of operation. V is defined such that V is coplanar to the polarization layer itself, and that it is parallel to the POP of any beam reflected by this layer.

V1 equals V2 equals V3 in the prior art described by Flood. Without the wave-plate between P1 and P3, the "S"-polarized sub-beam reflected at P1 into the axis A2 onto the polarizer layer P3, would again (as "S" polarized beam) be reflected by P3. Only by the addition of the wave-plate (half wave-plate), the reflected "S"-polarized beam will be transformed into a "P"-polarized beam by a rotation of its POP. This now converted "P"-polarized beam will, however, not be reflected by P3 but will be transmitted, because V3 = V1).

The same holds true for the initially "P"-polarized sub-beam. Without the wave-plate between P1 and P2, the "P"-polarized sub-beam transmitted at P1 along the axis A1 onto the polarizer layer P2, would again (as "P" polarized beam) be transmitted by P2. Only by the addition of the wave-plate (half wave-plate), the transmitted "P"-polarized beam will be transformed into a "S"-polarized beam by a rotation of its POP. The "S"-polarized beam will, however, not be transmitted by P2 but will be transmitted, because V2=V1.

The relation of the planes of polarizations of beams in the arrangement and the polarizing layers are expressed by the planes spanned by the polarizing vectors and the optical axes of the beams.

The plane spanned by V1 and A1 [E(V1,A1)] and the plane spanned by V2 and A1 [E(V2,A1)] are parallel/equal in the prior art of Flood (because V1=V2).

The plane spanned by V1 and A2 [E(V1,A2)] and the plane spanned by V3 and A2 [E(V3,A2)] are also parallel/equal in the prior art of Flood (because V1=V3).

The illustration R2 of this response shows the vectors and planes of the prior art of Fulkerson, who also employs one wave-plate in the arrangement between P1 and P2 and one wave-plate between P1 and P3. With respect to polarizing layer vectors Vi and planes, there is no difference between the prior arts of Flood and Fulkerson; both rely on the use of wave-plates; the complex polarizers would not work in the described way without the polarization rotating components. The mathematical relations are identical to those of Flood, and indicated below the drawing.

In contrast, our invention does not use additional polarization rotating parts between the polarizers to achieve the same performance as described in these prior arts.

Illustration R3 of this response shows the most general case of our invention. V1 is not necessarily orthogonal to the plane of incidence. (Imagine V1 to be parallel to the orientation of wire grids on the polarizer P1).

Now, and this is the important step, V3 is chosen such that the sub-beam reflected at P1 is transmitted by P3 without polarization rotating components between P1 and P3; and V2 is chosen such that the sub-beam transmitting P1 is reflected at P2 without polarization rotating components between P1 and P2. This results with a very special relation of the planes spanned by the optical axes and the polarizing layer vectors:

In our invention the plane spanned by V1 and A1 [E(V1,A1)] is perpendicular to the plane spanned by V2 and A1 [E(V2,A1)].

In addition, the plane spanned by V1 and A2 [E(V1,A2)] is perpendicular to the plane spanned by V3 and A2 [E(V3,A2)].

Remember that in the prior art these planes are parallel/equal. We are absolutely

convinced that this are two very distinct features of the invention, and clearly separate our invention from the prior art. Only this special relation will make the wave-plates in the design obsolete. - All disadvantages of including wavelength dependences, and additional parts (be it normal to the beam as a single element (Fulkerson) or coupled to one polarizer itself as in Flood) are resolved.

V2 and V3 must not equal V1 in our invention, while in the prior art V1=V2=V3.

Illustration R4 shows a special case of our invention, and was mainly included because of a remark made in the OA on page 5, under Claim Objections 10 d. (See detailed actions taken). It is also interesting because V1 has been chosen to be V1 of the prior art, which again sheds quits some light on the differences of our invention from the prior art.

If V1 is chosen to be V1 of the prior art (compare illustrations R1, R2 of this response) to be perpendicular to POI (or ground plane). We call this the orthogonal case (V1 could also be chosen to be parallel to POI), this has several profound effects: V2 and V3 will then, as shown in illustration R4, be parallel to the ground plane (moreover, it is possible that V2 equals V3). V2 and V3 will, only in this special orthogonal cases, be perpendicular to V1.

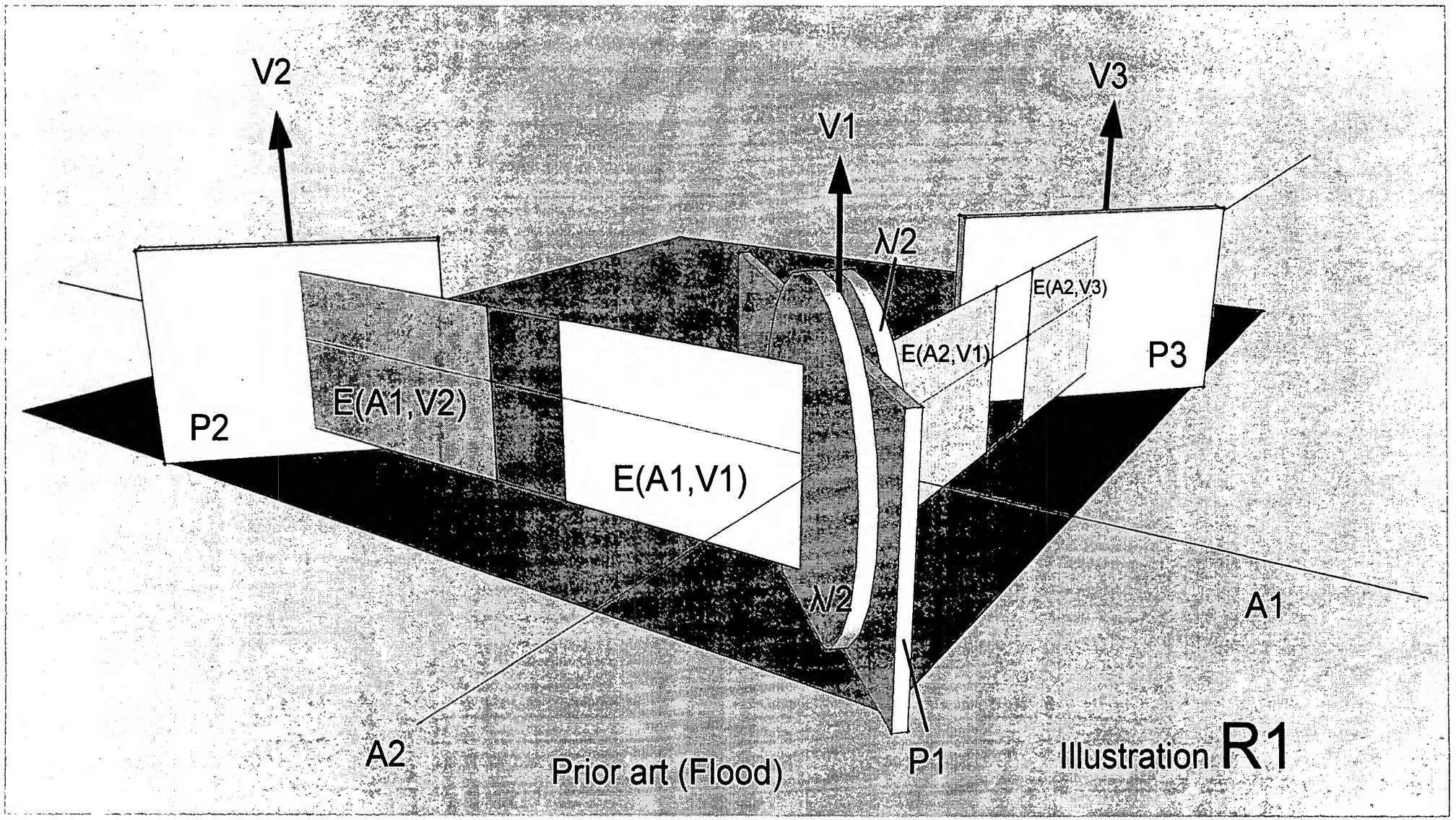
The orthogonal relations of the planes as a central property of the invention (claim 31) are also found in this special case. The special case is not theoretically, but practically of major importance.

We hope to have shed some light onto the layer vectors Vi , which are especially in the prior art literature admittedly only "virtually" contained. We hope that the fundamental difference of our invention, expressed by the perpendicular arrangement of the planes spanned by the axes and vectors, are now more readily seen and acceptable.

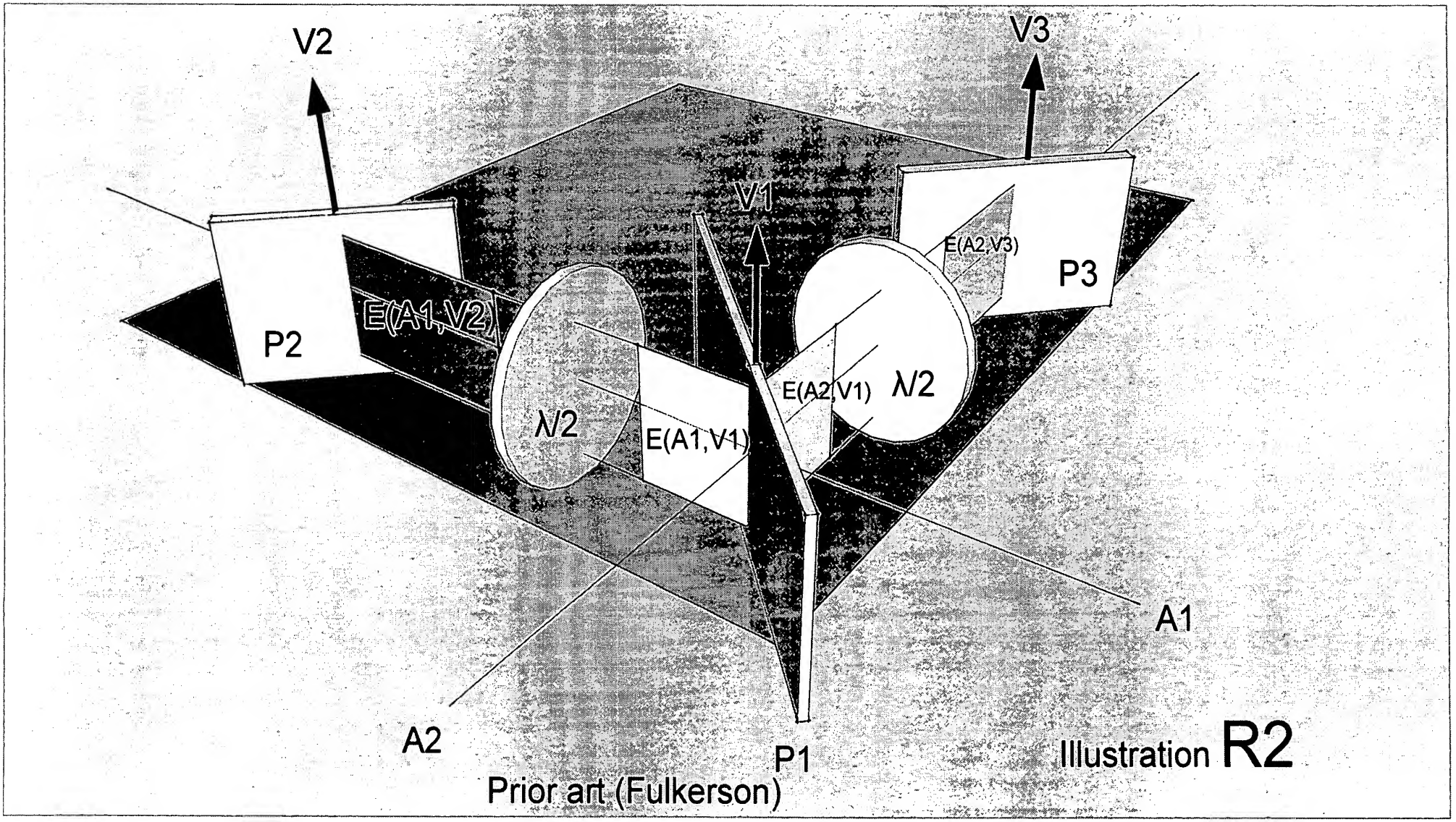
Following the interview and the OAs we have simplified the description and definition of

Vi in claim 31.

Moreover, we have followed your advice to include in the claim 31 that there are no polarization rotating components between the polarizing layers P1 and P2 in the generic claim, and added that there are no polarization rotating components between the polarizing layers P1 and P3.



Polarizing layer vectors: V1=V2=V3; all V ∟ ground plane (plane of incidence)
Planes: E(A1,V1) = E(A1,V2); E(A2,V1) = E(A2,V3)
The wave-plates (λ/2) have no influence on the geometry of Vi and derived planes E.



Polarizer layer vectors: V1=V2=V3; all V ∟ ground plane (plane of incidence)
Planes: E(A1,V1) = E(A1,V2); E(A2,V1) = E(A2,V3)
The wave-plates (λ/2) have no influence on the geometry of Vi and derived planes E.

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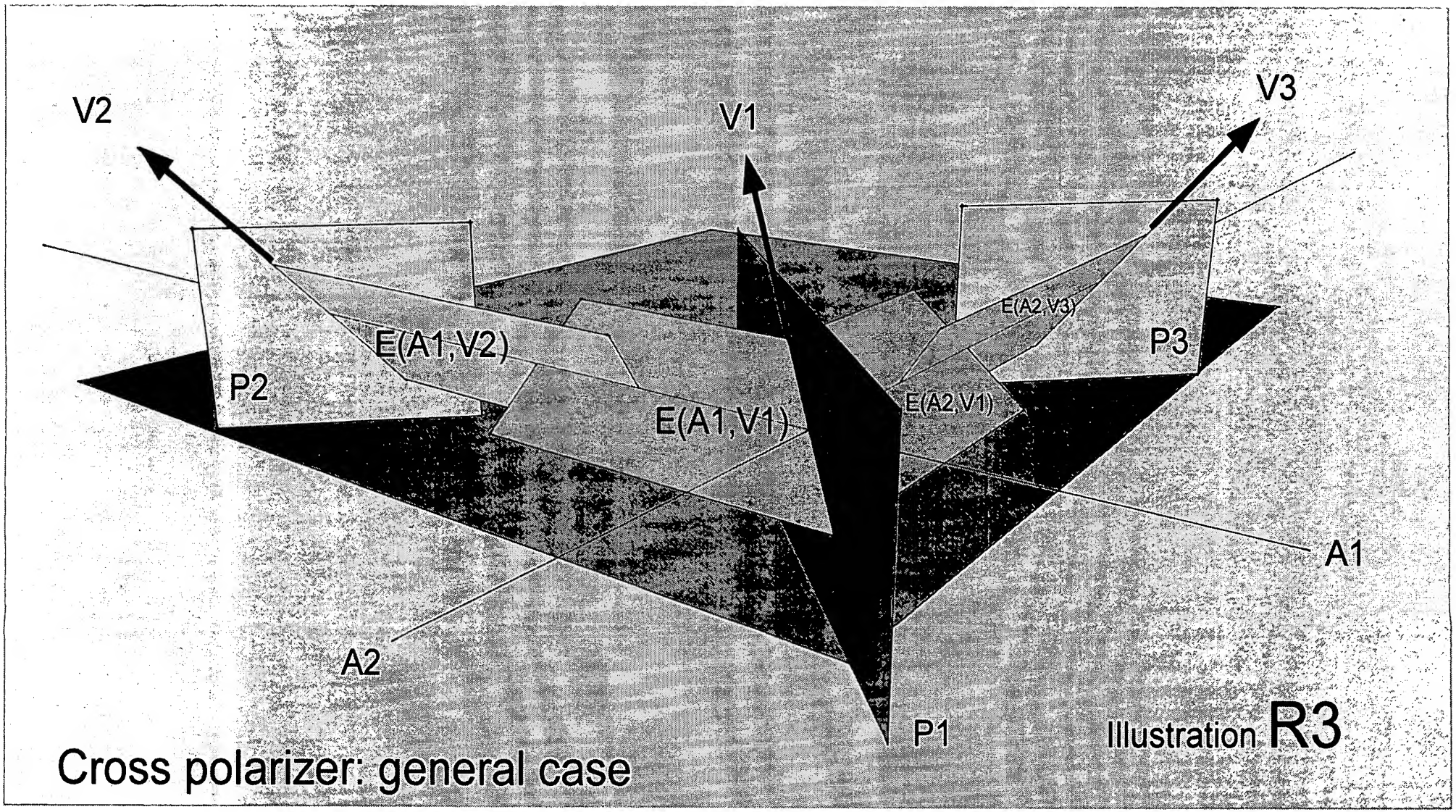

Polarizing layer vectors: V1≠V2; V1≠V3;
Planes: E(A1,V1) ∟ E(A1,V2);
E(A2,V1) ∟ E(A2,V3);

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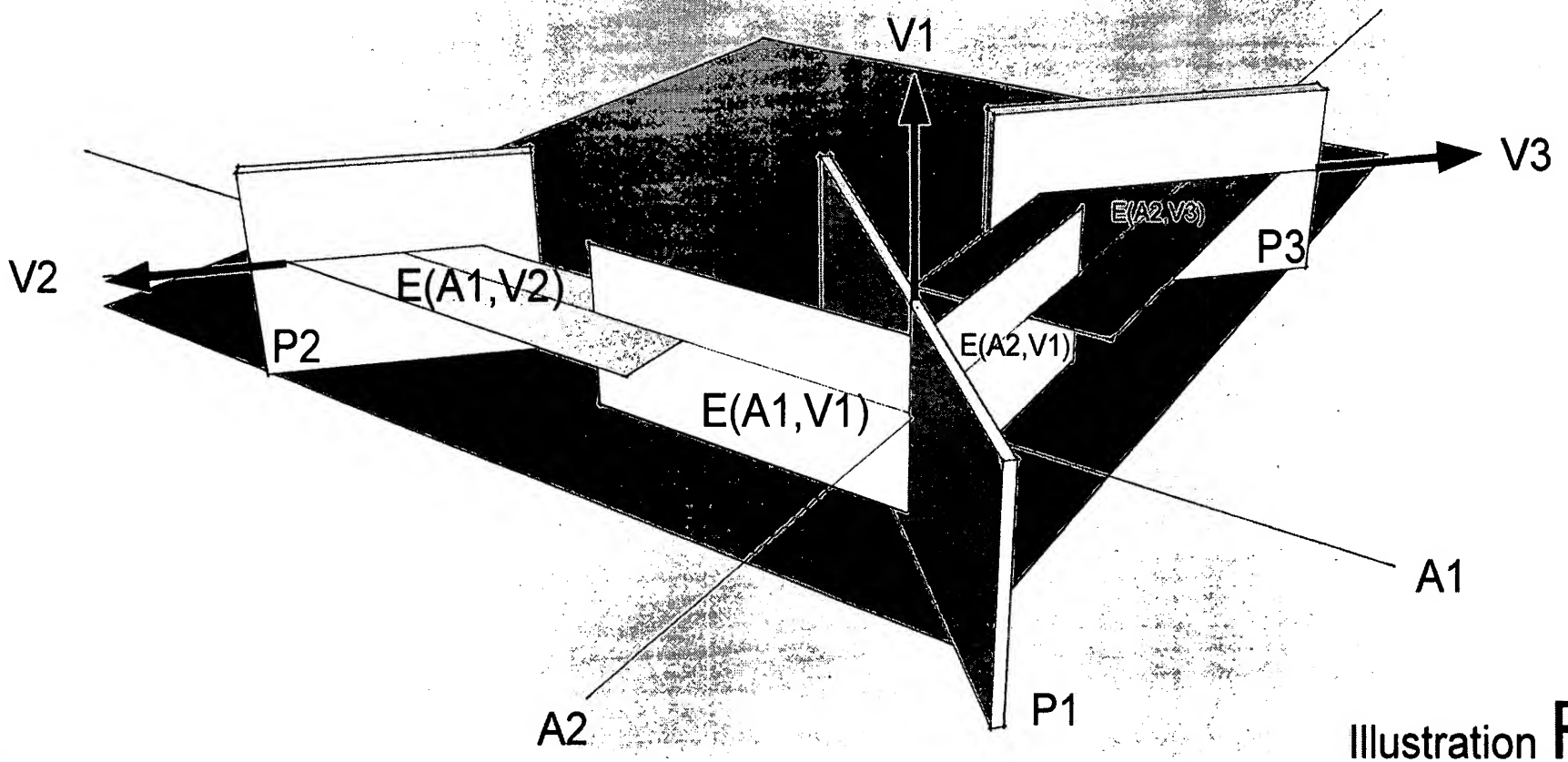

Illustration R4

Cross polarizer: special orthogonal case:

Polarizing layer vectors: V1 is chosen to equal V1 as determined in prior art:
V1 ∟ V2; V1 ∟ V3 (different from prior art!)

Planes: E(A1,V1) ∟ E(A1,V2);
E(A2,V1) ∟ E(A2,V3);

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Detailed actions following the OA and the interview:

OA 7,8) The abstract was objected. A new abstract, amending all the objections covered in the OA is part of this response.

OA 9) The Replacement of the specification is objected and was not entered.

In the replacement of the specification sent with the last amendment on April 15th, we had (together with many corrections which were required) included a new paragraph in the prior arts section, which was meant to appreciate the prior art found by the examiner. As being unfamiliar with the patent prosecution procedure (as the examiner puts it), we had (erroneously?) thought that prior art could never be new matter with respect to the invention. As an response to the OA, this response contains again a replacement for the specification, without the paragraph on prior art not covered by the original filing. The markings in the replacement specification relate to the original specification (because the former replacement appears not to be included in the IFW, as we have seen in the IFW only).

OA10) All informalities but 10d, were amended following the suggested corrections. The interpretation of the examiner in 10d is incorrect, and the notion is an important special case of the invention. We have provided the illustration R4 to show this special case. The end of the claim 21 thus still reads: V2 being perpendicular to V1.

All claims were amended to reflect the sample reading provided by the examiner to respect MPEP 608.01 (reference characters in parentheses).

OA11/12 Claim rejection 35 USC § 112

Claim 26 is amended to include the process which we wanted to encompass.

OA 13/14/15 Claim rejection 35 USC § 102

In OA 15, the examiner discloses that he was not able to transfer the core of our invention, namely the crossed planes spanned by the vectors and axes of the polarizing

layers, into the prior art. Such, the major part where he describes our invention to be anticipated by Flood relates to a central misconception and does not make sense.

OA15, page 8, the next-to-last paragraph says in the parenthesis following Vi "the plane along 12 into the page". Up to this point in the independent claim, there is no distinction from the prior art. However, it appears already here, that the examiner seems to refer to the polarizing vectors as being the planes of the polarizers. In any case, this connotation does make no sense but explains to us some of the difficulties that the examiner has to understand the following, distinction from the prior art:

On page 9, he writes, that Flood anticipates our invention in that (3rd paragraph)

"A1 and V2 span a plane which is normal to the plane spanned by A1 and V1 (see at least figure 1, elements P1 and P2". This property of our invention is clearly not fulfilled or anticipated by Flood, when V1 is defined as we have done this in claim 31. Illustration R1 of this response shows very clearly that V1 as defined by us equals V2 in Flood, and therefore the plane spanned by A1 and V1 is the same (or at least parallel) to the plane spanned by A1 and V2.

Also, a second distinctive property of our invention (next-to-last paragraph p.9) "such that A2 and V3 span a plane which is normal to the plane spanned by A2 and V1"... is not anticipated by the prior art.

We understand, when based on a wrong conception of the polarizing layer vector V, the rejection becomes understandable; but this is not compatible with the definition of the polarizing layer vector, as it was stated in the claim before our response.

Before this response, Vi is defined (citing claim 31): "Vi is defined to be coplanar to Pi and is defined such that a linearly polarized light beam propagating towards Pi is reflected at Pi if its plane of polarization is equal to the plane spanned by Vi and the propagation axis of said beam". We have learned from the rejection that this definition was hard to understand; we have therefor amended this definition, and removed the

somewhat recursive reference of Vi in its own definition.

Vi is now specified as such: "Vi equals the direction vector of the intersection line of Pi and the plane of polarization of any light beam reflected by Pi without further polarization rotating components."

We hope that this by far clearer mathematical description significantly simplifies the readability and understanding of Vi. Again, Vi is coplanar to the layer itself and is coplanar to the POP of any beam reflected by the polarizer.

Following the advice provided in the interview, we have also included the notion that there are no interjacent polarization rotating components between P1 and P2 and no interjacent polarization rotating components between P1 and P3. We still think that this is not a necessary addition (for the criteria of the crossed planes being sufficient to differentiate our invention from all prior art), but on the other hand we agree that this will help to make the differences more obvious.

OA 16-31 relate to dependent claims; all of these actions become invalid with the right understanding of Vi and the property of perpendicular planes E(A1,V1); E(A1,V2) and E(A2,V1);E(A2,V3).

OA 32 Claim Rejection 35 USC §103 Obviousness rejections

This point astounds us; for us in contrast it appears to be rather obvious that the prior art as pointed out by the examiner does not only employ wave-plates as additional parts while our invention achieves better performance without the at least two wave-plates; in fact, the prior art depends on the use of polarization rotating components. It is also rather obvious that the necessary inclusion on these wave-length depending components is a great disadvantage of these prior art disclosures (this holds for the non-normal positioning of the wave-plates as described by Flood and for the slightly better -normal positioning of the wave-plates by Fulkerson) compared to our invention.

OA 34-36 show the same misconception of Vi (36: "Flood discloses that V1 is

perpendicular to V2") as described earlier. (Vi being defined as a polarizing layer vector, not the normal vector describing the plane of Pi)!

OA 37 to 42 relate to dependent claims.

OA 43 Response to arguments

The examiner explains that we use "comprising" language and that therefore our remarks that Fulkerson has additional half-wave plates are not persuasive.

We agree that our remarks did not help to resolve the misunderstandings concerning V1 and the planes derived by Vi. We simply had not realized this Vi misconception before the final Office Action. This remark should, however, have shed some light on the obviousness of the invention, and as the examiner has pointed out in the interview, this was indeed the case.

In summary, we want to point out that in our former amendments and remarks we have not succeeded in explaining Vi and the planes derived by Vi, because we had not aimed at this point. We however, hope, that the basic misunderstanding was not only detected by the last OA and the interview, but could also be resolved by this response with its illustrations of V1,V2,V3 in the prior art as compared to our invention.

The definition of Vi was amended in the claims to make it much clearer; the geometric relation of the planes, which is the critical distinction of our invention to the prior art was also improved in the claims and explained in this response and its illustrations.

Finally, we included in the generic claim 31 that there are no wave-plates between P1 and P2 and no wave plates between P1 and P3; we think that this is not a necessary, but an additional property of the invention aimed at the obviousness of the invention.

We hope, that this response, with its several amendments, most of them required ones, will render this application in an allowable form. We are well aware that not only "our lack of familiarity with the US patent prosecution process", but more than that the fact

that our invention is based on the clever arrangement of only three polarizers (minimum form) without additional parts has proved to be a major challenge.

We are very grateful for the help provided by the Office for this - as we think quite clever - invention, which has so few components.

Respectfully submitted,

sincerely,

(Bernhard Bausenwein)
Tel: ++49 9453 996822
email bb@opti-project.de